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6. AUTHOR(S)

C.I. Byrnes

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Department of Systems Science and Mathematics
Washington University
Campus Box 1040
St. Louis, MO 63130

8. PERFORMING ORGANIZATION REPORT NUMBER

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ABSTRACT *(Maximum 200 words)*

This DEPSCOR proposal provided support of 2 graduate students to be trained in nonlinear control design. These students, Kenneth Doll and Rowena Eberhardt, performed research in the Doctoral Program of the Department of Systems Science and Mathematics. The doctoral program in SSM consists of taking certain basic courses in Systems, passing written and oral qualifying examinations, and then successfully completing doctoral research.

Rowena Eberhardt has completed all the requirements for the doctoral degree, which she will receive on May 17, 1996. She performed research in the area of optimal regulation, particularly in the analysis and design of optimal control laws for infinite time-horizon problems.

Kenneth Doll has completed all the requirements for the doctoral degree except the presentation and defense of his doctoral thesis, which is anticipated to be held during July, 1996. He is performing research in the area of robust nonlinear control, particualrly in the development of the nonlinear enhancement of the Popov criterion, the Circle Criterion and the Kalman-Yacubovitch-Popov Lemma for nonlinear passive systems.

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Final Technical Report: Doctoral Research in Nonlinear Control Systems

The design of feedback laws for systems characterized by complicated nonlinear dynamical behavior is a challenging research task which has attracted increasing interest in recent years. In the last ten years, the development of specific methodologies for the design of feedback laws in order to control systems described by nonlinear mathematical models has experienced major developments. Towards the end of the decade a renewed interest took place in the longstanding problem of asymptotic *stabilization*, leading to the development of systematic methods for the design of (locally or globally) stabilizing as well as *adaptively* stabilizing feedback laws for selected classes and/or interconnected structures of systems. In the meanwhile, methods of the solution of an outstanding problem of major engineering interest, the *asymptotic tracking* of prescribed reference signals as well as the *attenuation* (below a specified threshold) of exogenous disturbances, gradually became available.

There are currently two approaches to the problem of tracking/attenuation of exogenous inputs in a nonlinear system; one is the nonlinear extension of the classical *servomechanism problem* of linear system theory, in which the task of the regulator is to achieve asymptotic decay of a tracking error (the difference between the desired behavior and the actual behavior of the controlled variables). The other one is the nonlinear equivalent of the so-called H_∞*-optimal control problem* of linear system theory, in which the task of the regulator is to minimize the maximal amplitude of the frequency response of the system. The design methods developed at Washington University involve the consideration of certain nonlinear partial differential equations, which are extensions of the classical Sylvester equation, of the Hamilton-Jacobi equation of optimal control, and of the matrix Riccati equation.

USAFOSR has supported research and development in the research by the PI in the area of feedback system design for more than a decade and continues to do so in the parent grant. A particularly important part of the research in the "parent" grant AFOSF #91-0266 is devoted to nonlinear control system design.

This DEPSCOR proposal provided support of 2 graduate students to be trained in nonlinear control design. These students, Kenneth Doll and Rowena Eberhardt, performed research in the Doctoral Program of the Department of Systems Science and Mathematics. The doctoral program in SSM consists of taking certain basic courses in Systems, passing written and oral qualifying examinations, and then successfully completing doctoral research.

Rowena Eberhardt has completed all the requirements for the doctoral degree, which she will receive on May 17, 1996. She performed research in the area of optimal regulation, particularly in the analysis and design of optimal control laws for infinite time-horizon problems, generalizing work done by the PI using the Riccati partial differential equation for nonlinear optimal control. Her thesis is entitled "Optimal trajectories for infinite horizon nonlinear optimal control problems of Lagrange type." She is employed as a control engineer at McDonnell-Douglas Aircraft.

Kenneth Doll has completed all the requirements for the doctoral degree except the presentation and defense of his doctoral thesis, which is anticpated to be held during July, 1996. He is performing research in the area of robust nonlinear control, particularly in the development of the nonlinear enhancement of the Kalman-Yacubovtch-Popov Lemma for nonlinear passive systems, which involves solvability of a partial differential equation of Hamilton-Jacobi type. This has application to the development of robust stabilization schemes, including the Popov criterion, and the Circle Criterion, for nonlinear systems. He is expected to graduate in August, 1996.